Chapter 3
Outcomes Research in Cardiovascular Procedures

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ABSTRACT

In this case, the main objective is to examine information about patients with coronary artery disease who had invasive procedures (such as balloon angioplasty or stents), or coronary artery bypass surgery. We investigate the use of the drug-eluting stent as a treatment for coronary artery disease. The first section of this chapter is a brief background about coronary artery disease and different procedures that may be used as its treatment. Next, time series analysis as a statistical tool is discussed, and in the third section, the results of the time series analyses that are performed on the database are demonstrated. In this section, the effect of the drug-eluting stent as a new treatment on the demand of other procedures is discussed. The fourth section is about computing the risk of each procedure based on the claims database used. The last section includes the result, conclusion, and suggestions.

BACKGROUND

According to the results of a number of studies (P. Cerrito & J. C. Cerrito, 2006; Igor Singer, ; Loren, n.d.), heart disease is known as the number one killer of women in the United States. More than 250,000 women die from heart disease each year. In addition, 10 percent of women aged 45 to 64, and 25 percent of women over 65 have some kind of heart disease. Studies confirm that heart disease is the number one killer of Americans (Loren, n.d.). The cost of bypass surgery is very high. There is one hypothesis that a reasonable way to reduce the cost of treating heart disease while maintaining patient quality is to shift treatment from bypass to angioplasty with the drug-eluting stent. To investigate this hypothesis, a dataset provided by an insurance company has been used. It contained about 6,500,000 patient claims that were related to the years 2000-2005. This dataset was very multifaceted, and data processing was time consuming. In order to estimate the effect of the drug-eluting stent on bypass surgery as the two
alternative treatments, time series analyses was used. Different time series analyses are performed and compared to forecast the demand for each procedure and their costs. The risk of re-blocking an artery after each procedure (bypass surgery, drug-eluting stent, and bare stent) are estimated based on the probabilities of repetition of a procedure or having another procedure for the second or third time. Finally, for cost productivity and cost-effectiveness analysis of the drug-eluting stent as an advanced treatment, the Markov chain method was used.

Heart disease has the highest mortality rate of any chronic disease, particularly in the United States (Loren, n.d.). Any disease affecting the heart or blood vessels is called cardiovascular disease. It includes coronary artery disease, arteriosclerosis, heart valve disease, arrhythmia, heart failure, hypertension, orthostatic hypotension, shock, endocarditic, diseases of the aorta and its branches, disorders of the peripheral vascular system, and congenital heart disease percentage.

The breakdown of death from cardiovascular disease is

- 54% Coronary Heart Disease
- 18% Stroke
- 13% Other
- 6% Congestive Heart Failure
- 5% High Blood Pressure
- 4% Diseases of the Arteries
- 0.4% Rheumatic Fever/Rheumatic Fever Disease
- 0.4% Congenital Cardiovascular Defects

Figure 1 shows an image of a coronary artery. The heart muscle, like every organ or tissue of the body, needs oxygen-rich blood to survive. The main blood supplier to a body is called the aorta. It branches off into two main coronary blood vessels, which are called arteries; one on the left and one on the right side. By these two arteries, blood travels to all heart muscles. The left side of the heart is larger and more muscular compared to the right side, because the right side only pumps the blood to the lungs, but the left side pumps the blood to the rest of the body.

**Coronary Artery Disease**

Coronary artery disease appears when there is a narrowing or blockage of the coronary arteries (figure 2). These arteries provide blood for the heart muscle. When too many of the arteries are narrowed, or one crucial artery is blocked, the heart does not get enough oxygen. Often, a person with coronary artery disease will get chest pain, called angina. A heart attack (myocardial infarction) can happen when at least one of the coronary arteries is completely blocked. The heart attack can result in permanent damage to the heart.

There are currently two basic surgical methods used to unblock a coronary artery: Coronary Artery Bypass Graft (CABG), and Percutaneous Transluminal Coronary Angioplasty (PTCA) (Iezzoni et al., 1995).

**Coronary Artery Bypass Graft (CABG)**

Saphenous veins are taken from the leg, or the internal mammary artery is used to attach to the blocked artery (Figure 3).